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CLINICAL AND NEUROPSYCHOLOGICAL FEATURES OF VIOLENCE IN SCHIZOPHRENIA: A PROSPECTIVE COHORT STUDY

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ABSTRACT

The increased risk of violence in schizophrenia has been linked to several environmental, clinical and neuropsychological factors, including executive dysfunction. However, data about the nature of these effects are mixed and controversial. The main aim of this study was to investigate the relationship between clinical and neuropsychological factors with violence risk in patients with schizophrenia, taking into account current psychopathology and lifetime alcohol use. We compared a sample of patients living in Residential Facilities (RFs) with schizophrenia and a past history of interpersonal violence (vSZ, N=50) to patients with schizophrenia matched on age, gender and alcohol abuse/dependence but with no violence history (nvSZ, N=37). We then established the association between the clinical and neuropsychological factors that predicted violence over a 1 year follow-up period. The results revealed that vSZ patients living in RFs were characterized by greater compulsory hospital admissions, higher anger and less negative symptoms as compared to nvSZ patients. vSZ patients performed better on executive and motor tasks than nvSZ; however, these differences appeared to be explained by the lower negative psychotic symptom in the vSZ group. Both groups were involved in episodes of violence during the follow-up period; among the two, the vSZ patients were more likely to be violent. Negative symptoms predicted less verbal aggression at 1 year follow-up. Overall, these findings support a key role of negative rather than positive symptoms in driving violence risk among SZ patients living in RFs, in a manner that negative symptoms are linked to a lower risk of violence.

Key words: Cognition, Violence, Schizophrenia, Residential Facilities

1. INTRODUCTION

People with schizophrenia are more likely to be violent than people with other mental disorders or the general population (Walsh et al., 2002). The relationship between schizophrenia and violence is complex because of the interplay between many factors, such as having a past history of violence (Iozzino et al., 2015), age and gender (Swanson et al., 1990; Dack et al., 2013), current psychotic symptoms and childhood conduct problems (Hodgins, 2008), alcohol and substance misuse (Bowers et al., 2009).

From a neuropsychological perspective, deficits in executive functioning may be key components in the pathway that increases the propensity to violence in some patients with schizophrenia. This is consistent with evidence that abnormalities in fronto-temporal circuitry are implicated in aggressive behavior among such patients (Weiss, 2012).

Executive functions embrace higher order cognitive functions mainly sustained by prefrontal cortex, including mental flexibility, response inhibition, problem solving, self-monitoring and the ability to use feedback to modulate behavior (Lezak, 1995; Miyake et al., 2000). They may be modulated by dynamic factors, as psychotic symptoms (Bora et al., 2009), mood (Volkow, 2009) and alcohol/substance use (Harvey, 2011; Donoghue and Doody, 2012).

Data exploring the link between executive deficits and risk of violence in schizophrenia are inconsistent (Weiss et al., 2012; Witt et al., 2013). Current psychopathology, social reasoning and functioning have also been reported to be linked to violence (Serper et al., 2008; O'Reilly et al., 2015), though a recent meta-analysis found that only global cognitive impairment and lack of insight predicted violence in schizophrenia (Reinhardt et al., 2014).

Methodological challenges may help explain some of these inconsistencies, including small sample sizes, diagnostic heterogeneity, different clinical settings (i.e., community outpatient services, acute inpatient units and specialized forensic units), lack of standardization in the quantification of violence (Harris et al., 2013) and a failure to assess dynamic factors (Rueve and Welton, 2008; Dack et al., 2013).

The main aim of this study was to establish whether cognitive deficits are linked to the propensity to violence in patients with schizophrenia living in Residential Facilities (RFs). We examined the demographic and clinical characteristics of patients with

schizophrenia and a history of violence (vSZ) compared to those with no history of violence (nvSZ) (aim *i*). We compared these two groups on cognitive performances, taking into account potential confounding factors such as psychopathology and lifetime use of alcohol (aim *ii*). We then measured further acts of violence over 1 year (aim *iii*) and prospectively tested the roles of clinical and cognitive features in predicting the violence risk (aim *iv*).

We hypothesized that vSZ patients would exhibit higher anger scores and lifetime problematic alcohol use than nvSZ (*i*), and that vSZ patients would demonstrate impaired executive performances compared to nvSZ at baseline (*ii*). We also hypothesized that vSZ patients would be involved in higher rates of violence than nvSZ over the 1 year period (*iii*) and that current psychopathology and executive performance would predict that violence risk (*iv*).

2. MATERIAL AND METHODS

2.1 Study design and participants

This study was part of the VIOlence Risk and MEntal Disorders' ('VIORMED') project (de Girolamo et al., 2016). Patients were recruited from medium-long term RFs in 4 centers of the Saint John of God Order in Italy between May and September 2013. All RFs were non-hospital facilities which care for long-term psychiatric patients. In Italy in 2000 there were 1,370 RFs with 17,138 beds; most of them had 24-hour staffing with 1.42 patients per full-time worker and 12.5 beds per RF on average (de Girolamo, et al., 2002).

Fifty patients with schizophrenia and a past history of violence (vSZ) and 37 patients with schizophrenia without a violence history (nvSZ) were recruited, matched on age, gender and lifetime alcohol abuse/dependence as secondary diagnoses. We focused on alcohol because it was the most commonly abused drug in our sample; indeed all patients with lifetime abuse of other substances also abused of alcohol. Six eligible participants refused to participate.

All subjects had a primary diagnosis of a DSM-IV schizophrenia spectrum disorder (APA, 1994) as ascertained with the SCID-I (First et al., 2002), were aged between 18-65 years, lived in a RF at recruitment and were Italian fluent. Exclusion criteria were a diagnosis of mental retardation, dementia, organic brain disorder, or cancer. The study

was approved by the Ethical Committee (EC) of the Saint John of God Clinical Research Center in Brescia (Italy) as coordinating site, and by ECs of the other centers. All patients gave their written informed consent before entering the study.

2.2 Definition of “history of violence”

We defined “history of violence” as a categorical variable if the patient had committed an act of severe interpersonal violence in the last 10 years, as reported in the clinical records. Only “violent acts committed against others which caused (or might have caused) physical harm to the victim” were considered. If a patient committed several violent acts within this time frame, we included the act that had the most severe physical consequences for the victim.

2.3 Socio-demographic and clinical factors

Socio-demographic and clinical information were collected through a specific form at study entry; this tool also included an assessment of the past history of violence, such as age, mental state and type of violence, based on patients’ clinical records and interviews. Lifetime substance abuse was assessed using SCID-I. Current psychopathology was also evaluated using the Brief Psychiatric Rating Scale (BPRS) (Ventura et al., 1993) to yield total, positive and negative psychotic symptom scores (Ungvari et al., 2008). Psychosocial functioning was measured with Personal and Social Performance Scale (PSP) (Morosini et al., 2000) and patients’ self-awareness about their disorder using the Insight Scale (IS) (Markovà et al., 2003).

Lifetime aggressive behaviour was assessed through the Brown–Goodwin Lifetime History of Aggression (BGHA) (Brown et al., 1979). Impulsivity and anger were evaluated by the Barratt Impulsiveness Scale-11 (BIS-11) (Fossati et al., 2001) and the State-Trait Anger Inventory-2 (STAXI-2) (Cumunian, 2004).

2.4 Neuropsychological assessment

All patients underwent a neuropsychological assessment over a maximum of two sessions of about 45 minutes at study entry. All tests were administered and scored according to standard procedures.

The Brief Assessment of Cognition in Schizophrenia (BACS) (Anselmetti et al., 2008) was used to assess cognition broadly. The BACS evaluates verbal memory, working memory, motor speed, verbal fluency, attention and speed of information processing, and

planning. The cognitive foci were working memory (Digit Sequencing Task), motor speed (Token Motor Task), speed of information processing and attention (Symbol Coding Test).

The Wisconsin Card Sorting Test (WCST) (Laiacina et al., 2000) was used to test executive functioning. WCST performance was indexed using the total score, the number of perseverations and not perseverative errors as index of mental flexibility and inhibition.

The Iowa Gambling Test (IGT) requires inhibitory control and learning from external feedbacks. We employed an experimental computerized IGT task based on the original version (Bechara et al., 1994). The task involved four visually similar decks of cards, which can either provide high rewards and losses (disadvantageous decks: A and B) or small rewards and losses (advantageous decks: C and D). The aim is to maximize the starting budget of \$ 2,000. The subject is allowed to pick from any of the decks for a total of 100 cards, one at a time. After turning a card, the subject is informed of their gain or loss. Performance was evaluated in final total budget and net score. The net score was calculated as $[(C+D) - (A+B)]$, where positive net score reflects advantageous performance and negative net score reflects disadvantageous performance.

2.5 Monitoring violence during the 1 year follow-up

Patients' behavior was reviewed twice a month by medical staff blind to the baseline evaluations. The Modified Overt Aggression Scale (MOAS) (Margari et al., 2005) was used to rate the most severe violent behavior exhibited in the previous two weeks across four domains of violence: verbal, physical, against property and self-aggression. Thus, each patient had a total of 24 MOAS evaluations. For patients discharged from the RF, the new treating psychiatrist (at the Department of Mental Health, DMH, or in another RF) was contacted to complete the MOAS. Weighted scoring of the MOAS was used throughout (Kay et al, 1988).

To select violent acts of at least low-moderate severity, those patients who had a total MOAS score ≥ 3 were categorized as 'new violent' and included in the analyses of predictors.

2.6 Follow-up at 1 year

At the end of the monitoring, patients were reassessed using BPRS, FPS, STAXI-2 and BIS-11.

2.7 Statistical analysis

Socio-demographic and clinical characteristics were compared between the two groups (vSZ *vs* nvSZ) using the appropriate statistics according to the nature of the data (t-test with Cohen's *d* and its 95% confidence interval for continuous variables, and Chi-square with Odds Ratios (OR), and its 95% confidence interval for categorical variables). Adjusted scores were considered for neuropsychological measures based on their Italian validation. Group differences of cognitive variables were assessed with and without adjustments for BPRS Negative Score and lifetime problematic use of alcohol as covariates, with ANOVA and ANCOVA models respectively. Coefficient of determination R^2 and the partial eta square effect size were computed in order to describe the ratio of variance explained in the dependent variable by a predictor while controlling for other predictors.

Given the non-Gaussian (skewed and zero-inflated) distribution of the MOAS score, generalised linear models with tweedie distribution and log-link function were adopted for analysing the predictors of violent behaviour. Total MOAS score (and MOAS subscales) was used as dependent variable; continuous and categorical measures as independent variables.

All tests were two-tailed, with statistical significant set at $p = 0.05$. All data were analysed using the SPSS Statistics for Windows, Version 21.0.

3. RESULTS

3.1 Socio-demographic and clinical factors

The groups did not differ on any socio-demographic variables at baseline (Table 1). The vSZ group had higher BGHA scores ($t=2.4$, $p=0.019$, $d=0.5$ [0.1, 0.9]) and were more often admitted compulsorily over their lifetime ($t=5.0$, $p<0.001$, $d=1.2$ [0.7, 1.6]) than the nvSZ group. The groups did not differ on rates of lifetime problematic alcohol use ($\chi^2=2.1$, $p=0.147$, OR=0.5 [-0.2, 1.3]).

Even if it did not reach statistical significance, the vSZ group had lower total BPRS and higher PSP scores than the nvSZ group at study entry. The vSZ groups were rated significantly lower on the BPRS Negative Scale ($t=-3$, $p=0.004$, $d=-0.6$ [-1.1, -0.2]), but higher for STAXI-2 RT/R ($t=2.0$, $p=0.049$, $d=0.4$ [0, 0.8]) and STAXI-2 ER/Out indices ($t=3.3$, $p=0.002$, $d=0.7$ [0.2, 1.1]), which respectively refer to the tendency of experiencing anger during frustrating situations, and of exhibiting anger toward others or objects.

TABLE 1**3.2 Assessment of violence history**

The majority of vSZ patients were already known to a DMH at the time of their violent act (N=36, 72%). Forty-four individuals committed some forms of severe assaults, that ranged from striking someone to attempted murder and murder. One committed stalking. The most violent acts occurred in the context either of impulse dysregulation (N=34, 68%) or in a delusional state (N=36, 72%). Rates of alcohol or drug intoxication were relatively uncommon at the time of the assaults (N=14, 28%).

3.3 Neuropsychological assessment

Even under the cut-off (Table 2), the vSZ group outperformed the nvSZ group on several BACS and WCST measures. vSZ subjects had significantly higher BACS motor speed score ($F=7.60$, $p=0.007$, $\eta^2=0.1$), lower WCST Global Score ($F=5.39$, $p=0.023$, $\eta^2=0.1$) and Perseverations ($F=5.24$, $p=0.025$, $\eta^2=0.1$) compared to the nvSZ group. On the IGT, vSZ patients performed less well than controls, though the differences were not significant.

Since the vSZ and nvSZ groups differed significantly on negative psychotic symptoms and previous work suggested associations between psychotic psychopathology and alcohol abuse on cognition, we decided to enter the BPRS Negative Score and a lifetime problematic use of alcohol into the ANCOVA model. When those covariates were entered, BACS motor speed, WCST Global Scores and Perseverations no longer differed significantly between groups ($F=2.34$, $p=0.130$, $\eta^2=0.03$; $F=2.45$, $p=0.122$, $\eta^2=0.03$, and $F=2.56$, $p=0.114$, $\eta^2=0.03$, respectively). Only the BPRS Negative score had a significant effect on BACS Token Motor Task, WCST Global Score and Perseverations.

TABLE 2**3.4 Violence during the 1 year follow-up**

The vSZ patients (N=50) yielded significantly higher scores in the total and verbal MOAS mean scores compared to nvSZ patients (N=37). In details, for total score vSZ had a mean of 6.9 (Standard Error=1.4) vs nvSZ with a mean of 2.4 (SE=1.2) ($t=2.4$, $p=0.018$); for verbal aggression score: vSZ mean=3.3 (SE=0.8) vs nvSZ mean=0.9 (SE=0.3) ($t=2.8$, $p=0.006$). vSZ patients also obtained higher scores at aggression against property score (vSZ mean=1.1, SE=0.3 vs nvSZ mean=0.8, SE=0.5; $t=0.4$, $p=0.680$), self-aggression score

(vSZ mean=0.06, SE=0.06 *vs* nvSZ mean=0) and physical aggression score (vSZ mean=2.4, SE=0.8 *vs* nvSZ mean=0.6, SE=0.5; $t=1.9$, $p=0.062$).

As we screened for the total MOAS score ≥ 3 , twenty-eight individuals (32%) were classified as ‘new violent’ patients. Twenty-two (44%) belonged to the vSZ group and 6 (16%) to the nvSZ group, showing a significant association between having a history of violence and new episodes of violence ($X^2=7.5$, $p=0.006$). They committed a total of 48 new episodes of violence, including 25 episodes of verbal aggression, 11 acts of property violence, 10 acts of interpersonal violence and 2 of self-aggression. The MOAS mean scores (of each subscale) of the ‘new violent’ patients are shown in Figure 1.

Figure 1

3.5 Prediction of aggression during 1 year follow-up

Generalized linear models were used to predict violence propensity indexed on the MOAS over 1-year follow-up period (Table 3). Twenty-eight patients classified as “new violent” were included in this analysis. Variables that were significant in the previous analyses, baseline BPRS Negative symptom score, BGHA, STAXI-2_RT_R, STAXI-2_ER_out, WCST Perseveration, BACS Token Task and history of violence, were included as independent variables. Only the BPRS Negative symptom score significantly predicted MOAS verbal aggression in an inverse manner ($\beta=-0.55$, $p<0.001$), meaning that higher levels of negative symptoms were associated with a lower risk of verbal aggression. The association between BPRS Negative Score and MOAS verbal aggression remained significant ($\beta=-0.11$, $p=0.008$) after adjusting for the history of violence (vSZ *vs* nvSZ).

TABLE 3

4. DISCUSSION

This is one of the first studies that aimed to prospectively identify the clinical and neuropsychological features of violent behavior among patients with schizophrenia living in RFs.

The majority of vSZ patients were followed-up by DMHs at the time of their violent act. This may demonstrate the difficulty to make accurate risk predictions to prevent violence. vSZ patients were more likely to have been admitted involuntarily in the past and showed higher BGHA scores.

As in Candini et al. (2015), the violent group had lower levels of negative symptoms and better global functioning compared to controls. Negative symptoms have also been shown to characterize schizophrenia patients at a lower risk of violence in the community (Swanson et al., 2006).

Although there were no group differences in impulsivity on the BIS-11, results from STAXI-2 revealed that vSZ patients were more likely to experience and exhibit anger than controls. Indeed, violence is the external expression of anger (Spielberger and Sydeman, 1994) and may play a crucial role in linking psychotic symptoms with violence (Coid et al., 2013; Ullrich et al., 2014).

Contrary to our hypothesis, vSZ patients outperformed controls on executive tasks in a manner that has been found in the past (Lapierre et al., 1995; Rasmussen et al., 1995). Further, we found that this was primarily linked to lower levels of negative symptoms (i.e., blunted affect, withdrawal, disorientation) in the vSZ group, through an inverse correlation between cognitive performances and the severity of negative psychotic symptoms.

Twenty-eight (32%) patients were violent during the 1 year follow-up period. Despite the heterogeneity of violence types, this result is broadly in line with the small number of studies which reported violence rates that ranged between 11 and 50% in psychiatric residential settings (Flannery et al., 2000a; 2000b).

It is interesting to note that while 44% of those who have a past history of violence continued to act violently in the RFs, the majority (56%) were not. These findings could be linked to the relatively high levels of clinical stability that the patients achieved in these RFs, linked to high compliance with both medical and psychosocial interventions (de Girolamo et al., 2005).

4.1 Strengths

This study is one of the first to prospectively investigate the association between clinical, neuropsychological factors and violence risk in a relatively large sample of patients with schizophrenia. We focused on schizophrenia spectrum disorders as these represent the most frequent diagnostic group in these RFs.

Further, it employed a comprehensive multidimensional assessment strategy and a standardized instrument to quantify violence over the follow-up period.

The results may help define the clinical profile of patients with schizophrenia who pose the greatest risk of violence, and provide insights to inform future research as well as violence prevention and treatment.

4.2 Limitations

As we considered long-term patients with schizophrenia in RFs, our results are not generalizable to other diagnostic groups or patients living in the community. Similarly, we were unable to assess the effect of medication on violence and cognition.

We did not include IQ measures; however, a clinical diagnosis of mental retardation was an exclusion criterion. We only included a problematic use of alcohol, as it was the substance abused by all the patients.

Violence history was dichotomized in vSZ and nvSZ groups. It was assessed from medical charts, as this was the source of information available for all patients living in RFs.

5. CONCLUSIONS

While there is an association between schizophrenia and violence risk, the assessment of that risk remains a difficult area of investigation, which can delay patients discharge to more independent community settings. In our study, only a minority of patients were violent during the 1 year follow-up. A history of past violence, greater compulsory admissions, higher anger, lower psychotic negative symptoms and better executive functioning distinguished vSZ from nvSZ patients. However, only negative symptoms were linked to cognition and predicted violence at 1 year. More research is needed to improve our understanding of the relationship between violence, cognition and schizophrenia in residential and other settings.

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Figure legend

Figure 1. 'New violent patients' (N=28): mean MOAS scores with standard errors bars across 24 evaluations (1 year follow-up).

Table legend

Table 1. Socio-demographic and clinical characteristics, self-reported impulsivity and aggression.

Table 2. Neuropsychological scores differences between groups with and without adjustment for BPRS Negative Score and lifetime problematic use of alcohol as covariates.

Table 3. Predictors of violence during 1 year follow-up (total MOAS score ≥ 3).

Table 1. Socio-demographic and clinical characteristics, self-reported impulsivity and aggression.

	vSZ (<i>n</i> =50)		nvSZ (<i>n</i> =37)		Statistical Test, <i>p</i> -value	Effect size [95% CI]
	N (%)	Mean (SD)	N (%)	Mean (SD)		
Gender <i>male</i>	46 (92%)		32 (86.5%)		$\chi^2=0.7, p=0.486$	OR=1.8 [-0.4, 7.2]
Age (<i>years</i>)		46.7 (10.0)		49.2 (9.9)	$t=-1.2, p=0.244$	$d=-0.3$ [-0.7, 0.2]
Education						
<i>Primary school</i>	42 (84%)		32 (86.5%)		$\chi^2=0.1, p=0.748$	OR=0.8 [-0.2, 2.7]
<i>Professional and high school</i>	8 (16.0%)		5 (13.5%)			
Occupation						
<i>Unemployed</i>	42 (85.7%)		36 (97.3%)		$\chi^2=3.4, p=0.130$	OR=0.2 [-0.02, 1.4]
<i>Employed</i>	7 (14.3%)		1 (2.7%)			
Age at the first contact with the DMH (<i>years</i>)		27.4 (9.4)		24.2 (6.8)	$t=1.6, p=0.105$	$d=0.4$ [-0.1, 0.8]
Mean duration of the schizophrenia disorder (<i>years</i>)		34.2 (30.4)		30.5 (19.0)	$t=0.7, p=0.492$	$d=0.1$ [-0.3, 0.57]
Length of stay in the last Residential Facility (<i>years</i>)		3.4 (4.2)		3.0 (3.5)	$t=0.4, p=0.669$	$d=0.1$ [-0.3, 0.5]
Lifetime number of compulsory admissions		1.9 (1.0)		0.8 (0.8)	$t=5.0, p<0.001$	$d=1.2$ [0.7, 1.6]
Lifetime problematic use of alcohol	18 (36.0%)		8 (21.6%)		$\chi^2=2.1, p=0.147$	OR=0.5 [-0.2, 1.3]
First generation antipsychotics	32 (65.3%)		18 (54.5%)		$\chi^2=1.0, p=0.327$	OR=0.6 [-0.3, 1.6]
Second generation antipsychotics	41 (83.7%)		26 (78.8%)		$\chi^2=0.3, p=0.575$	OR=0.7 [-0.2, 2.2]
BPRS Total Score		58.5 (25.0)		63.2 (19.5)	$t=-1.0, p=0.336$	$d=-0.2$ [-0.6, 0.2]
BPRS Positive Score		14.0 (7.1)		13.7 (4.8)	$t=0.1, p=0.911$	$d=0.1$ [-0.4, 0.5]
BPRS Negative Score		8.9 (4.3)		11.9 (5.2)	$t=-3.0, p=0.004$	$d=-0.6$ [-1.1, -0.2]
IS		11.7 (6.7)		13.5 (6.6)	$t=1.267, p=0.209$	$d=-0.3$ [-0.7, 0.2]
PSP		38.6 (16.1)		37.2 (15.8)	$t=0.4, p=0.688$	$d=0.1$ [-0.3, 0.5]
BGHA		38.9 (12.5)		32.6 (11.0)	$t=2.4, p=0.019$	$d=0.5$ [0.1, 0.9]
BIS-11		64.9 (12.2)		67.6 (13.8)	$t=-0.95, p=0.345$	$d=-0.2$ [-0.6, 0.2]
STAXI-2_RT_R		7.2 (3.2)		6.1 (1.9)	$t=2.0, p=0.049$	$d=0.4$ [0, 0.8]
STAXI-2_ER_out		15.5 (6.4)		11.9 (3.4)	$t=3.3, p=0.002$	$d=0.7$ [0.2, 1.1]

V: violent; Nv: not violent; SZ: schizophrenia; DMH: Department of Mental Health; BPRS: Brief Psychiatric Rating Scale; IS: Insight Scale; PSP: Personal and Social Performance Scale; BGHA: Brown–Goodwin Lifetime History of Aggression; BIS-11: Barratt Impulsiveness Scale-11; STAXI-2: State-Trait Anger Inventory-2. Mean (SD) for continuous variables and frequency and percentage for categorical variables are reported. Bold data indicate tests in which vSZ and nvSZ patients showed significant different scores. OR: odds ratio; d: Cohens’*d*, CI: Confidence Interval 95%.

Table 2. Neuropsychological scores differences between groups with and without adjustment for BPRS Negative Score and lifetime problematic use of alcohol as covariates.

Outcomes	vSZ (n=50) Mean (SD)	nvSZ (n=37) Mean (SD)	Cut-off	F ^a	R ² _a	Partial η^2_a	<i>p-value</i>	F ^b	R ² _b	Partial η^2_b	<i>p-value</i>
BACS List Learning	35.1 (11.9)	30.5 (13.2)	>33.01	2.68	0.03	0.03	0.105	0.21	0.2	0.1	0.651
BACS Digit Sequencing Task	14.5 (5.9)	14.1 (6.1)	>14.93	0.08	0.0	0.0	0.78	0.75	0.1	0.01	0.39
BACS Token Motor Task	48.0 (19.4)	35.7 (19.9)	>68.77	7.60	0.1	0.1	0.007	2.34	0.3	0.03	0.130#
BACS Verbal Fluency	32.2 (13.0)	28.7 (14.9)	>31.68	1.24	0.01	0.01	0.268	0.14	0.3	0.0	0.708
BACS Symbol Coding	18.0 (12.0)	14.6 (10.8)	>40.49	1.68	0.02	0.02	0.198	0.01	0.2	0.0	0.945
BACS Tower of London	10.8 (7.9)	9.5 (7.4)	>12.37	0.51	0.0	0.0	0.478	0.31	0.2	0.0	0.578
WCST Global score	71.4 (36.9)	90.6 (31.7)	<90.6	5.39	0.1	0.1	0.023	2.45	0.1	0.03	0.122#
WCST Perseveration	30.9 (20.4)	46.5 (37.3)	<42.7	5.24	0.1	0.1	0.025	2.56	0.1	0.03	0.114#
WCST Errors	34.7 (29.4)	44.4 (33.0)	<30.0	1.75	0.02	0.02	0.190	0.21	0.1	0.0	0.651
IGT Final Budget	1,595.19 (1,272.94)	1,895.6 (914.1)	na	1.35	0.02	0.02	0.248	0.31	0.1	0.0	0.581
IGT Net score	-4.4 (46.9)	7.2 (34.3)	na	1.47	0.02	0.02	0.230	0.20	0.1	0.0	0.653

V: violent, Nv: not violent, SZ: schizophrenia; BACS: Brief Assessment of Cognition in Schizophrenia; WCST: Wisconsin Card Sorting Test; IGT: Iowa Gambling Task; na: not applicable. Raw scores are indicated (mean and standard deviation between blankets). Cut-off scores according to Italian normative data are reported. Bold data indicate test in which significant group differences were found.

F^a F statistic of ANOVA model with no covariates.

F^b F statistic of ANCOVA models with BPRS Negative Score and lifetime problematic use of alcohol as covariates.

R²_a coefficient of determination of ANOVA model with no covariates.

R²_b coefficient of determination of ANCOVA model with BPRS Negative Score and lifetime problematic use of alcohol as covariates.

η^2_a eta-squared of ANOVA model with no covariates.

η^2_b eta-squared of ANCOVA model with BPRS Negative Score and lifetime problematic use of alcohol as covariates.

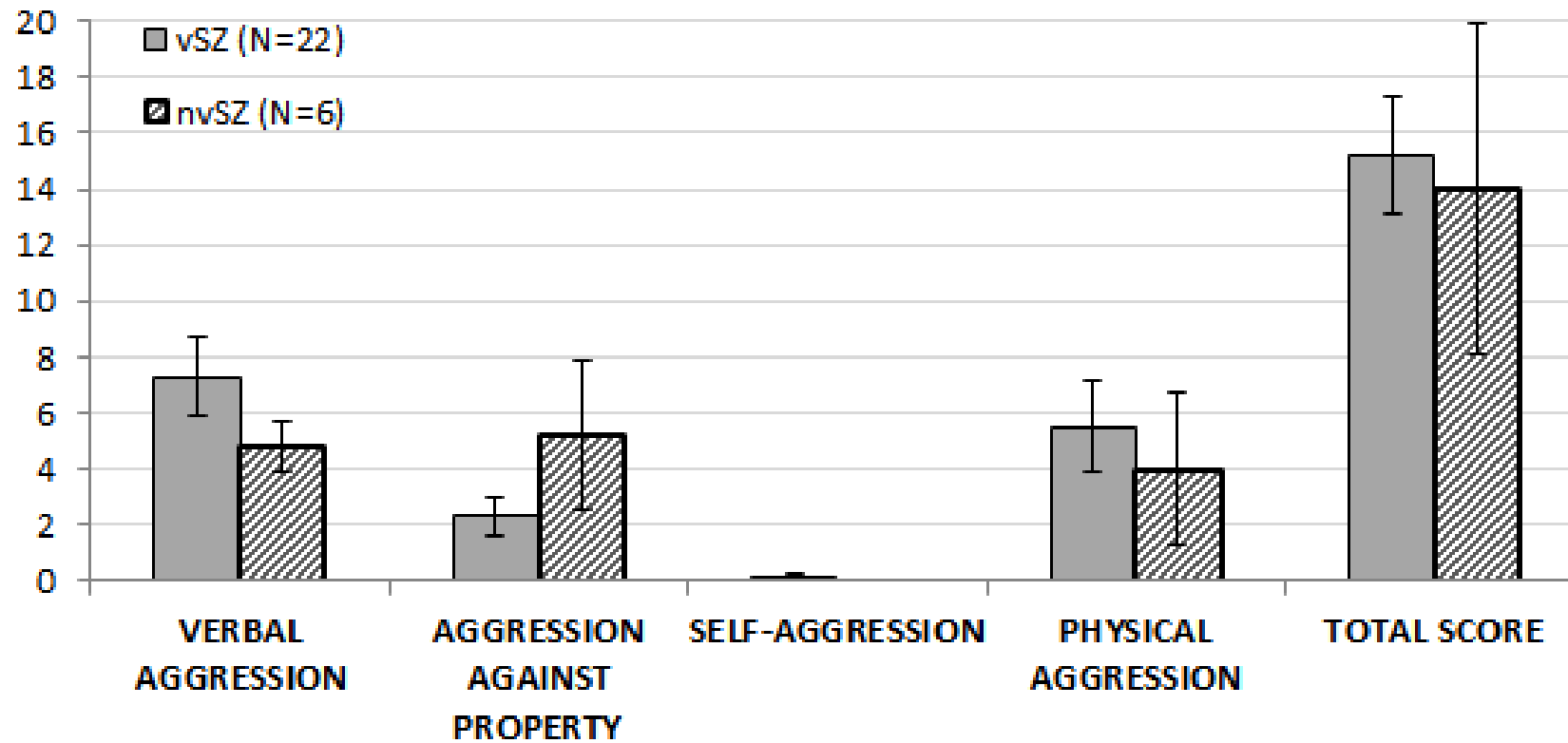
BPRS Negative Score significantly affects the outcomes

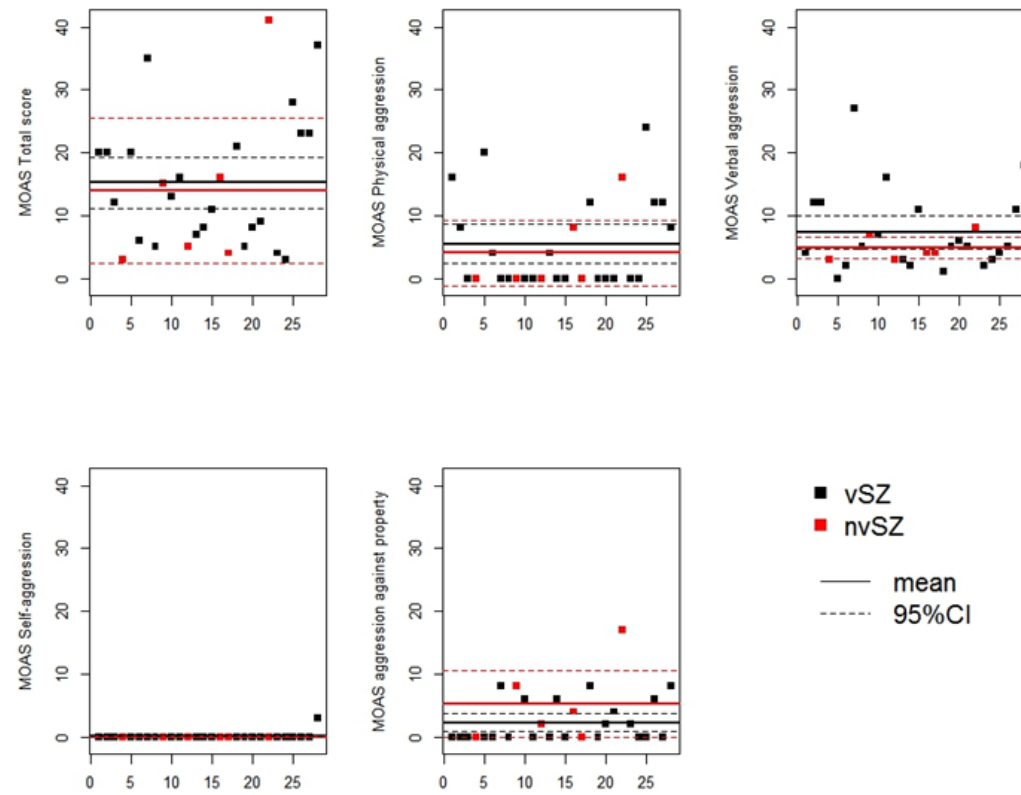
Table 3. Predictors of violence during 1 year follow-up (total MOAS score ≥ 3).

Predictors	MOAS total score B (<i>p-value</i>)	MOAS- Verbal aggression B (<i>p-value</i>)	MOAS- Aggression against property B (<i>p-value</i>)	MOAS- Physical aggression B (<i>p-value</i>)
BPRS Negative Score	-0.70 (0.061)	-0.55 (<0.001)	-1.12 (0.197)	0.09 (0.836)
BGHA	0.09 (0.499)	-0.004 (0.758)	-0.03 (0.294)	0.02 (0.262)
STAXI2_RT_R	0.38 (0.558)	0.52 (0.195)	-0.05 (0.724)	0.01 (0.924)
STAXI2_ER_out	-0.10 (0.713)	-0.10 (0.713)	-0.01 (0.781)	-0.01 (0.908)
BACS Token task	-0.06 (0.556)	0.09 (0.146)	-0.01 (0.608)	-0.02 (0.332)
WCST Perseveration	0.11 (0.424)	0.01 (0.929)	0.02 (0.365)	0.01 (0.688)
History of violence (yes <i>vs</i> no)	0.08 (0.793)	0.42 (0.269)	-0.82 (0.261)	0.31 (0.731)

V: violent, Nv: not violent, SZ: schizophrenia; MOAS: Modified Overt Aggression Scale; BPRS: Brief Psychiatric Rating Scale; BGHA: Brown-Goodwin Lifetime History of Aggression; STAXI-2: State-Trait Anger Inventory-2; BACS: Brief Assessment of Cognition in Schizophrenia; WCST: Wisconsin Card Sorting Test. Bold data indicate a significant association. Note: Among patients with total MOAS ≥ 3 , the MOAS "Self-aggression" subscale was constantly equal to zero; thus, it was not evaluated here.

Figure 1. 'New violent patients' (N=28): mean MOAS scores with standard errors bars across 24 evaluations (1 year follow-up).





Details of data presented in Fig. 1. Scatterplots of individual mean MOAS total scores and individual mean MOAS subscale scores.